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U.S. NAVAL PROVING GROUND

Dahlgren, Virginia



REPORT NO. 15-43

EXAMINATION OF JAPANESE 37MM AMMUNITION

BY

Lt. W.S. Pellini

AD-222049

19 July 1943.

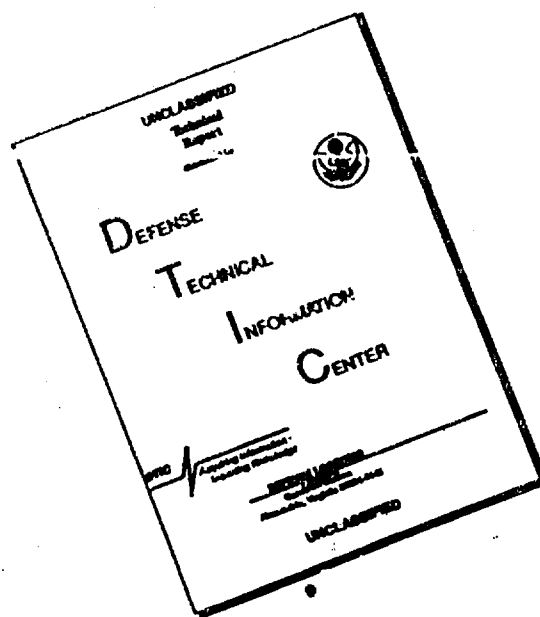
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NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO. 15-43.

19 July 1943.

EXAMINATION OF JAPANESE 37MM AMMUNITION..

NAVAL PROVING GROUND CAPTURED ENEMY EQUIPMENT.

REPORT NO. 77.

APPROVED:

David I. Hedrick
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Previous Report: 5-43.

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P R E F A C E

AUTHORIZATION

Specific directives for this investigation were issued in Buord ltr EF74(Relb) dated 17 February 1943.

OBJECT

To make a physical, chemical and metallurgical study of one complete round of Japanese 37mm ammunition.

SUMMARY

This report is supplementary to Naval Proving Ground Report No. 5-43, Captured Enemy Equipment Report No. 57. It is shown that the present ammunition differs, from the same caliber ammunition previously examined, in the following respects:

- (a) The projectile was machined from steel of approximate SAE 1080 grade, as compared to SAE 1060 used in the former.
- (b) The nose-hardening heat treatment has been altered to eliminate a pronounced weakness.
- (c) The cartridge case is shorter in length and has a larger diameter.
- (d) A decoppering foil is used containing 63% tin, 22.5% lead and 15% zinc. Japanese foils examined previously contained only traces of zinc, it appears that the zinc has been used to substitute for lead.

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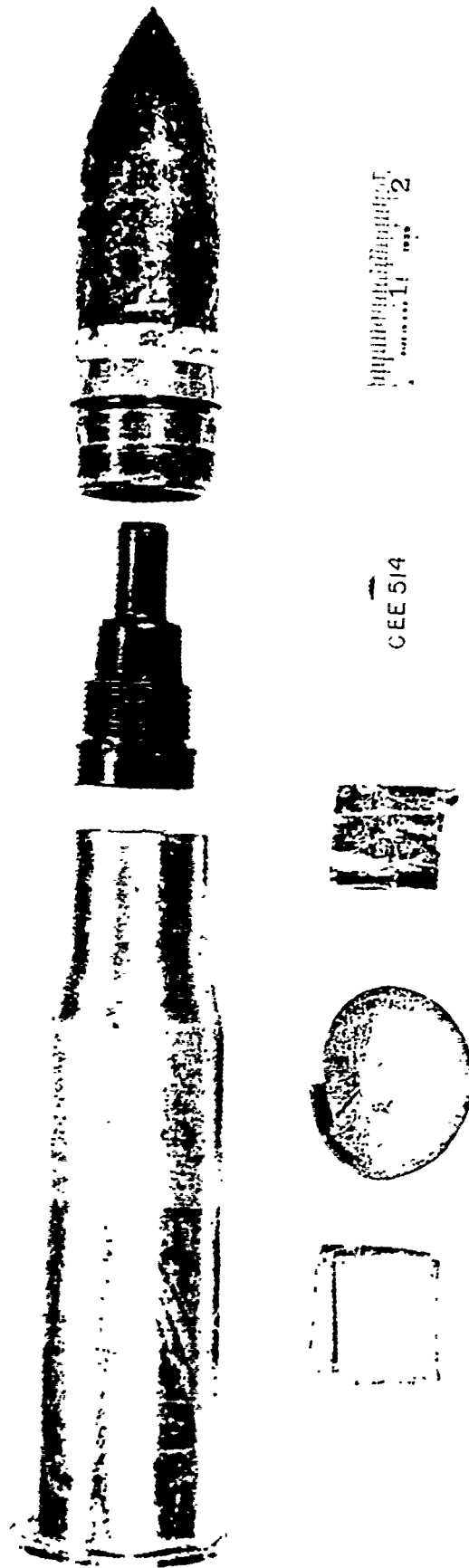
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NPG PHOTO NO. 731 (APL) - Examination of Enemy Weapons. Report No. 77.
 Japanese 37mm A.P. ammunition; projectile, fuze, cartridge case and
 decoupling pin as received. CEE 514.
 22 June, 1943.

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Figure 1

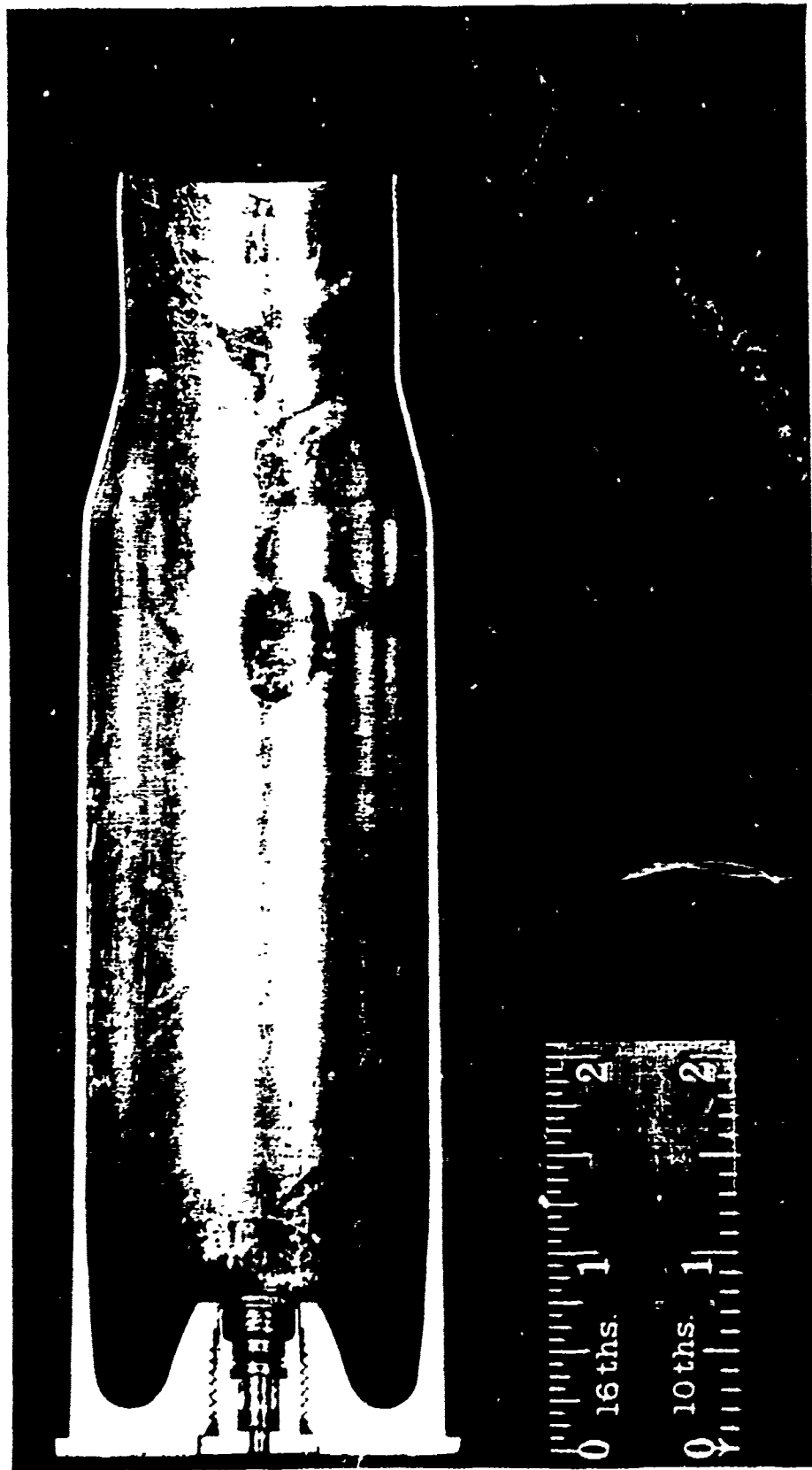


CEE 514

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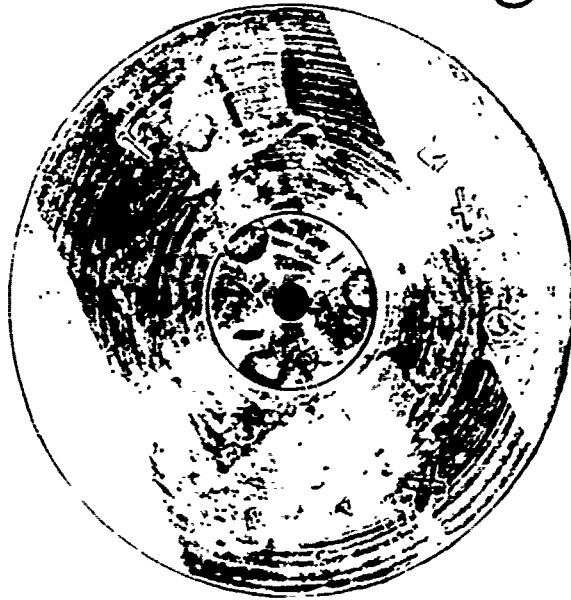
REF: M. P. R. 744 (A.P.L.) - Examination of Enemy Weapons. Report No. 77.
Section of Japanese 37mm A.P. cartridge case. SEE 514.
22 June, 1943.

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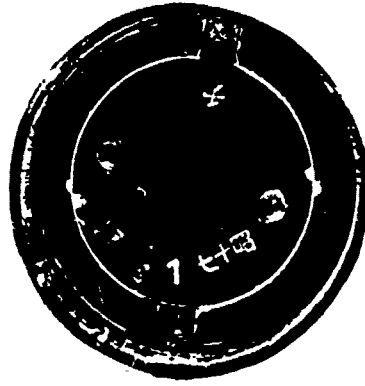


NPG PHOTO NO. 739 (APL) - Examination of Enemy Weapons. Report No. 77.
Japanese 37mm A.P. ammunition; base view of cartridge case and projectile.
CEE 514.
22 June, 1943.

Figure 2 - CONFIDENTIAL -



CEE 514



MADE IN U.S.A.

I INTRODUCTION

One complete round of Japanese 37mm A.P. ammunition was received by the Armor and Projectile Laboratory of the Naval Proving Ground, Dahlgren, Virginia, for physical, chemical and metallurgical examination.

This ammunition was assigned Buord identification number CEE 514.

II INVESTIGATION

PHYSICAL

A projectile and fuze similar to those previously reported on in Naval Proving Ground Report No. 5-43, Captured Enemy Equipment Report No. 57 is used in this ammunition; the cartridge case, however, is of a different design.

Component parts of this ammunition are shown in Fig. 1 and the principal characteristics are listed in Table A.

TABLE A

PROJECTILE

Weight: 1.19 lbs.

Capacity: Without fuze, 1.3 cu. in.; with fuze, .81 cu. in.

Identification markings: Black nose, orange and yellow bands at bourrelet, black on body, white band fore of rotating band, black on boattail.

CARTRIDGE CASE

Weight: .88 lbs.

Propellant capacity: 12.2 cu. in.


Identification Markings:

On base: ~~17~~ 125 AR

On primer: 14 E 11 H + 8 ~~E~~ ~~D~~ ~~X~~

FUZE

Weight: .5 lbs.

Identification Markings: 7t + 

DECOPPERING FOIL

Weight: 1.312 gms.

Thickness: .001 in.

TABLE B

CHEMICAL ANALYSES OF JAPANESE 37MM A.P. AMMUNITION

<u>C</u>	<u>P</u>	<u>S</u>	<u>Mn</u>	<u>Si</u>	<u>Cr</u>	<u>Ni</u>	<u>Mo</u>	<u>V</u>	<u>Ti</u>	<u>W</u>	<u>Cu</u>
.83	.018	.033	.68	.34	.08	.06	NT	NT	NT	NT	T
Previous projectile											
.59	.023	.026	.79	.28	NT	.05	T	NT	T	NT	T

	<u>Cu</u>	<u>Zn</u>	<u>Sn</u>	<u>Pb</u>	<u>Fe</u>	<u>Ni</u>
Case	62.4	36.9	.05	.03	.55	--
Primer	59.5	39.8	.18	.05	.27	.10
Foil	--	14.7	62.7	22.5	--	--
Rotating Band	100					

CHEMICAL

Chemical analyses of the component parts of this ammunition are given in Table B. Steel analyses are spectrochemical with the exception of carbon, phosphorus and sulphur, which have been obtained by standard wet-chemical procedures. Non-ferrous analyses are wet-chemical.

The projectile analysis, corresponding roughly to steel of SAE 1080 grade, shows a higher carbon content than the projectile examined previously which was made from steel similar to SAE 1060 grade.

While the design of the cartridge case is indicated as being quite different from the former one investigated, it is interesting to note that the two analyses are almost identical. Surprisingly, it is not of the familiar 70-30 composition, but approaches the analysis of a Muntz Metal, although it is definitely of inferior grade, containing appreciable iron and lead which are considered undesirable in cartridge brass.

The decoppering foil is quite unlike Japanese foils examined previously in that it contains considerable zinc. It appears that the zinc has been added as a substitute for lead, which is considered a critical metal in Japanese war economy.

Usual Japanese practice is shown in the primer which is made from Muntz metal.

METALLURGICAL

In design and manufacture the projectile of this ammunition was found to be similar to the projectile previously reported on, being machined from bar stock to approximately the same profiling. The chemical analysis, as given in Table A, shows that there has been no change in the composition of the steel, except for carbon which has been increased from .59% to .83%.

The heat treatment, as indicated by a study of the hardness distribution and microstructure shown in Fig. 4, has been improved to eliminate a serious weakness which existed at approximately mid-body.

APPENDIX A, 887(ARL) - Examination of enemy weapons, Report No. 77.

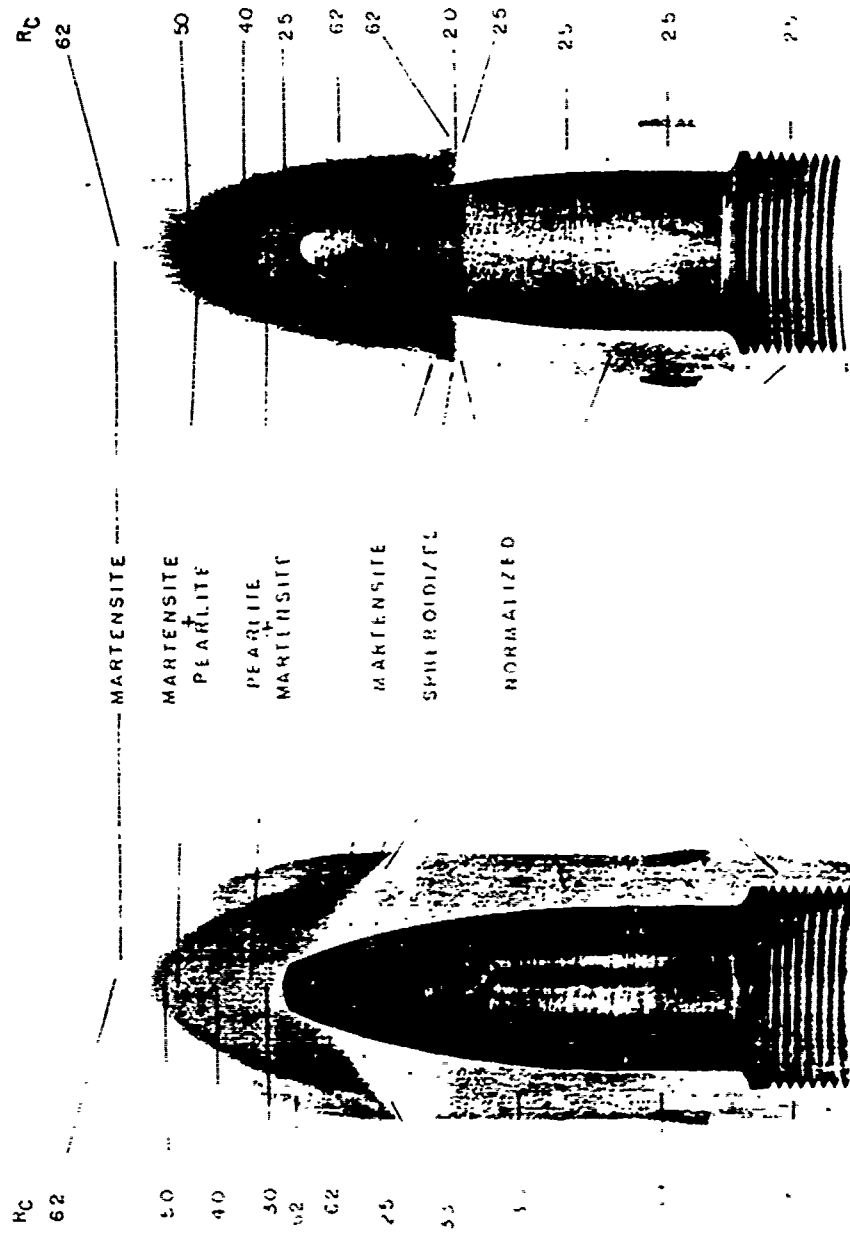
Several etched sections of Japanese 37mm projectiles showing the nature of heat treatments and hardness distribution, projectile of present and previous investigation. The projectiles have identical nose profile, note that cutting was slightly off-center in the projectile file of the previous investigation which resulted in the rounded appearance of this nose section.

Figure 4.

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During nose hardening, the noses of the projectiles are immersed in a molten salt or metal bath to a predetermined depth and held for a fixed time. Fig. 4 shows that the previously examined projectile was immersed to mid-body, and held for too long a time, which resulted in complete austenitization of the nose half of the projectile. The quenching and tempering which followed then produced the extremely sharp hardness drop from 62 to 20 Rc at mid body. This weakness has been eliminated in the present projectile, by immersing only up to the bourrelet, and by holding for a time sufficient to austenitize the immersed metal only as far as the nose of the cavity. Quenching and tempering produced a drop in hardness, 62 to 25 Rc, similar to that noted previously, but its position has been moved forward and the soft zone does not extend to the cavity.

The increase of the carbon content from .60% to .80% is interesting because this permits the present projectile to be tempered at a higher draw temperature than the 0.60% carbon projectile to obtain the same nose hardness. The higher tempering temperature probably results in a projectile of increased toughness.